Software Infrastructure for Sustained Innovation - S2I2 (SI2-S2I2)

PROGRAM SOLICITATION
NSF 13-511

REPLACES DOCUMENT(S):
NSF 11-589

National Science Foundation

Office of Cyberinfrastructure

Directorate for Biological Sciences

Directorate for Engineering

Directorate for Mathematical & Physical Sciences

Full Proposal Deadline(s) (due by 5 p.m. proposer's local time):

February 04, 2013

IMPORTANT INFORMATION AND REVISION NOTES

A revised version of the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG), NSF 13-1, was issued on October 4, 2012 and is effective for proposals submitted, or due, on or after January 14, 2013. Please be advised that the guidelines contained in NSF 13-1 apply to proposals submitted in response to this funding opportunity. Proposers who opt to submit prior to January 14, 2013, must also follow the guidelines contained in NSF 13-1.

Please be aware that significant changes have been made to the PAPPG to implement revised merit review criteria based on the National Science Board (NSB) report, National Science Foundation's Merit Review Criteria: Review and Revisions. While the two merit review criteria remain unchanged (Intellectual Merit and Broader Impacts), guidance has been provided to clarify and improve the function of the criteria. Changes will affect the project summary and project description sections of proposals. Annual and final reports also will be affected.

A by-chapter summary of this and other significant changes is provided at the beginning of both the *Grant Proposal Guide* and the *Award & Administration Guide*.

Please note that this program solicitation may contain supplemental proposal preparation guidance and/or guidance that deviates from the guidelines established in the Grant Proposal Guide.

Important Information

As one round of S2I2 conceptualization awards have now been made, this program solicitation seeks proposals that focus on areas not covered by the previous awards.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Software Infrastructure for Sustained Innovation - S2I2 (SI2-S2I2)

Synopsis of Program:

NSF's vision of a Cyberinfrastructure Framework for 21st Century Science and Engineering (CIF21) identifies advancing new computational infrastructure as a priority for driving innovation in science and engineering. Software is an integral enabler of computation, experiment and theory and a central component of the new computational infrastructure. Scientific discovery and innovation are advancing along fundamentally new pathways opened by the development of increasingly sophisticated software. Software is also directly responsible for increased scientific productivity and significant enhancement of researchers' capabilities. In order to nurture, accelerate and sustain this critical mode of scientific progress, NSF has established the Software Infrastructure for Sustained Innovation (SI^2) program (http://www.nsf.gov/si2/), with the overarching goal of transforming innovations in research and education into sustained software resources that are an integral part of the cyberinfrastructure. SI^2 is a long-term

investment focused on catalyzing new thinking, paradigms, and practices in developing and using software to understand natural, human, and engineered systems. It is NSF's expectation that the SI^2 investment will result in robust, reliable, usable and sustainable software infrastructure that is critical to the CIF21 vision and will transform science and engineering while contributing to the education of next generation researchers and creators of future cyberinfrastructure. Education at all levels will play an important role in integrating such a dynamic cyberinfrastructure into the fabric of how science and engineering is done.

The SI^2 program includes three classes of awards:

1. **Scientific Software Elements (SSE):** SSE awards target small groups that will create and deploy robust software elements for which there is a demonstrated need that will advance one or more significant areas of science and engineering.

2. **Scientific Software Integration (SSI):** SSI awards target larger, interdisciplinary teams organized around the development and application of common software infrastructure aimed at solving common research problems. SSI awards will result in sustainable community software frameworks serving a diverse community.

3. **Scientific Software Innovation Institutes (S2I2):** S2I2 awards will focus on the establishment of long-term hubs of excellence in software infrastructure and technologies that will serve a research community of substantial size and disciplinary breadth.

This solicitation is focused on the Scientific Software Innovation Institutes (S2I2) class of awards. Two subclasses of awards are planned for the S2I2 part of this program: *Conceptualization Awards*, which are planning awards aimed at organizing an interdisciplinary community and understanding their software requirements and challenges, and *Implementation Awards,* which will be made to implement community plans for software infrastructure, such as those developed by the conceptualization awards. **In FY13, the only S2I2 Awards that will be made will be Conceptualization Awards.**

Please refer to (i)A Vision and Strategy for Software for Science, Engineering, and Education (NSF 12-113) and (ii)Implementation of NSF Software Vision (http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504817) for further information about NSF's vision for software as part of cyberinfrastructure and the programs that support this vision.

Successful proposals must reflect the quality, commitment, and planning that will be needed to lead to full Implementation awards.

The Office of Cyberinfrastructure would be particularly interested in proposals that address the set of broad issues related to general SI^2 software, including sustainability, software lifecycle/ecosystem, governance, verification & validation, reproducibility, etc.

The Biological Sciences Directorate would be particularly interested in proposals that that focus on high priority research problems and that will significantly leverage existing investments in ways that transform the infrastructure in support of BIO and BIO-related research. For further information about BIO's interests in S2I2 see the Dear Colleague Letter of November 22, 2011 (NSF 12-019).

The Engineering Directorate would be particularly interested in partnerships with the goal for open-access software integrating major interdisciplinary advances of significant impact to the engineering community.

The MPS/Astronomy Division will consider supporting proposals that would have a clearly demonstrated impact on a significant portion of the astronomy research community.

The MPS/Materials Research Division would be particularly interested in proposals that advance priorities in the Materials Genome Initiative.

The MPS/Division of Mathematical Sciences would be particularly interested in proposals that include the creation, development, and application of new mathematical and statistical theories and tools.

The MPS/Physics Division will consider proposals that will significantly advance fundamental research in Physics.

Please note that successful proposals will demonstrate clear and compelling science-driven goals that are responsive to research priorities identified across and within participating units. It is strongly recommended that prospective PIs contact program officers from the list of Cognizant Program Officers to ascertain that the scientific focus of the proposed work is appropriate for this solicitation.

Proposals submitted to NSF in response to this solicitation must have a clear relevance to the overall SI^2 program and should be responsive to this solicitation and its review criteria. Proposals that are not relevant or not responsive to the solicitation will not be considered for funding and will be returned without review.

Proposals must also be in areas not covered by previous S2I2 awards. (For a list of previous awards, see Implementation of NSF Software Vision [http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504817].) Participants who are interested in areas already covered should contact the relevant current S2I2 team(s) to participate in those ongoing conceptualization activities.

Cognizant Program Officer(s):

Please note that the following information is current at the time of publishing. See program website for any updates to the points of contact.

- Daniel S. Katz, Program Director, OD/OCI, telephone: (703) 292-2254, email: SI2queries@nsf.gov
- Peter H. McCartney, Program Director, BIO/DBI, telephone: (703) 292-8470, email: SI2Queries@nsf.gov
- Sumanta Acharya, Program Director, ENG/CBET, telephone: (703) 292-7494, email: SI2queries@nsf.gov
- Clark Cooper, Program Director, ENG/CMMI, telephone: (703) 292-7899, email: SI2Queries@nsf.gov
- Eduardo A. Misawa, Program Director, ENG/EEC, telephone: (703) 292-5353, email: SI2Queries@nsf.gov
- Jean Cottam Allen, Program Director, MPS/PHY, telephone: (703) 292-8783, email: SI2queries@nsf.gov

- Daryl W. Hess, Program Director, MPS/DMR, telephone: (703) 292-4942, email: SI2Queries@nsf.gov
- Andrew D. Pollington, Program Director, MPS/DMS, telephone: (703) 292-4878, email: SI2Queries@nsf.gov
- Thomas Statler, Program Officer, MPS/AST, telephone: (703) 292-4910, email: SI2queries@nsf.gov

Applicable Catalog of Federal Domestic Assistance (CFDA) Number(s):

- 47.041 --- Engineering
- 47.049 --- Mathematical and Physical Sciences
- 47.074 --- Biological Sciences
- 47.080 --- Office of Cyberinfrastructure

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 3 to 5

The actual number of S2I2 Conceptualization awards may vary based on the quality of proposals, responsiveness to the solicitation, and availability of funds. Note that funded conceptualization awards may lead to full implementation awards in the future, but that the number of full implementation awards will be smaller than the number of conceptualization awards. No S2I2 Implementation awards will be made in FY13.

Anticipated Funding Amount: $1,500,000 to $2,500,000 - Estimated program budget, size and number of awards is subject to the availability of funds. Pending availability of funds, up to $2,500,000 will be available for proposals submitted in response to this solicitation.

Eligibility Information

Organization Limit:

Proposals may only be submitted by the following:

- Universities and Colleges - Universities and two- and four-year colleges (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Such organizations also are referred to as academic institutions.
- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.

PI Limit:

None Specified

Limit on Number of Proposals per Organization:

None Specified

Limit on Number of Proposals per PI:

None Specified

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Not Applicable
- **Preliminary Proposal Submission:** Not Applicable
- **Full Proposals:**
  - Full Proposals submitted via FastLane: NSF Proposal and Award Policies and Procedures Guide, Part I: Grant Proposal Guide (GPG) Guidelines apply. The complete text of the GPG is available electronically on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg.
  - Full Proposals submitted via Grants.gov: NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov Guidelines apply (Note: The NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide)

B. Budgetary Information

- **Cost Sharing Requirements:** Inclusion of voluntary committed cost sharing is prohibited.
- **Indirect Cost (F&A) Limitations:** Not Applicable
- **Other Budgetary Limitations:** Not Applicable

C. Due Dates

- **Full Proposal Deadline(s)** (due by 5 p.m. proposer's local time):

February 04, 2013

Proposal Review Information Criteria

Merit Review Criteria: National Science Board approved criteria. Additional merit review considerations apply. Please see the full text of this solicitation for further information.

Award Administration Information

Award Conditions: Additional award conditions apply. Please see the full text of this solicitation for further information.

Reporting Requirements: Standard NSF reporting requirements apply.

TABLE OF CONTENTS

I. INTRODUCTION

Software Infrastructure for Sustained Innovation (SI ^{2}) is a bold and long-term investment focused on realizing the *Cyberinfrastructure Framework for 21 st Century Science and Engineering (CIF21)* vision and catalyzing new thinking, paradigms and practices in science and engineering. CIF21 envisions a linked cyberinfrastructure architecture that integrates large-scale computing, high-speed networks, massive data archives, instruments and major facilities, observatories, experiments, and embedded sensors and actuators, across the nation and the world, and that enables research at unprecedented scales, complexity, resolution, and accuracy by integrating computation, data and experiments in novel ways. CIF21 has the potential for revolutionizing virtually every discipline by providing unique insights into complex problems, and thus creates unique opportunities for understanding natural, human and engineered systems.

Software is a primary modality through which CIF21 innovation and discovery will be realized. It permeates all aspects and layers of cyberinfrastructure (from application codes and frameworks, programming systems, libraries and system software, to middleware, operating systems, networking and the low-level drivers). The CIF21 software infrastructure must address the complexity of this cyberinfrastructure, accommodating disruptive hardware trends, ever-increasing data volumes, complex application structures and behaviors and emerging concerns such as fault-tolerance and energy efficiency. It is clear that the community must redefine research, development, and maintenance of software in the context of CIF21 and make significant long-term investments commensurate with hardware investments. The resulting program must focus on building robust, reliable and sustainable software that will support and advance sustained scientific innovation and discovery.

The Office of CyberInfrastucture (OCI) is partnering with Directorates and Offices across the foundation to support SI ^{2}, a long-term comprehensive program focused on realizing a sustained software infrastructure that is an integral part of CIF21. The goal of this program is to catalyze and nurture the interdisciplinary processes required to support the entire software lifecycle, and result in the development of sustainable community software elements and reusable components at all levels of the software stack. The program addresses all aspects of cyberinfrastructure, from embedded sensor systems and instruments, to desktops and high-end data and computing systems, to major instruments and facilities.

The goal of the overall SI ^{2} program is to create a software ecosystem that scales from individual or small groups of software

innovators to large hubs of software excellence. It is envisioned that the SI ^{2} program will collectively support vibrant partnerships between academia, government laboratories and industry, including international entities, for the development and stewardship of a sustainable software infrastructure that can enhance productivity and accelerate innovation in science and engineering, while contributing to the education of next generation researchers and creators of future cyberinfrastructure.

II. PROGRAM DESCRIPTION

Scientific Software Innovation Institutes (S2I2) will focus on the establishment of long-term hubs of excellence in software infrastructure and technologies, which will serve a research community of substantial size and disciplinary breadth. It is expected that outcomes of S2I2 goes beyond the software itself and also includes the infrastructure and process by which software is developed and sustained in response to, and to successfully enable, transformative new science. These institutes will provide expertise, processes and architectures, resources, and implementation mechanism to transform computational science and engineering innovations and community software into robust and sustained software infrastructure for enabling science and engineering, which in turn will transform research practices and productivity. S2I2 proposals are expected to bring together interdisciplinary teams of scientists, engineers, and educators together with software engineers and technologists.

An S2I2 proposal must describe the vision and rationale for the proposed institute as a multi-faceted enterprise with credible connections to the community it serves. The proposal must make a compelling case for the institute's need and scope, and state its anticipated impact on the target communities. Furthermore, in addition to innovating in the domain (or domains) and the computational and computer science aspects of the software, the proposals must also focus on the required processes and services necessary to support the community. The institutes will provide necessary structures and mechanisms for support, outreach, and workforce development, with a proactive approach to diversity, and will stimulate interaction between all stakeholders through various means including the definition of joint research directions, community standards and models, and collaborative development activities. The institutes will also provide pathways for community involvement, enabling software elements developed within the community to be transitioned to conform to community software frameworks, standards and processes, and to be made accessible, usable and extendible by the community. Institutes are encouraged to leverage existing infrastructure investments. Where appropriate, involvement with industry and government laboratories, and partnering with international efforts are encouraged. Proposals should identify a clear set of near- mid- and long-term goals, and how it will organize itself to accomplish those goals. Finally, it should also include a model for longer-term sustainability of the institute itself.

S2I2 awards are subdivided into Conceptualization and Implementation awards which are described below. **In FY13, the only S2I2 Awards that will be made will be Conceptualization Awards.**

(a) Conceptualization Awards: S2I2 Conceptualization Awards are planning awards aimed at organizing an interdisciplinary community and understanding their software requirements and challenges. Example activities that may be undertaken as part of this award include focused workshops, special sessions at professional meetings, sandpits, focus groups, etc. These awards will typically be 1 year in duration. The product of a conceptualization award will be a strategic plan for enabling science and education through a sustained software infrastructure that will be freely available to the community, and will address the following elements:

- the science community and the specific grand challenge research questions that the S2I2 will support;
- specific software elements and frameworks that are relevant to the community, the sustainability challenges that need to be addressed, and why addressing these challenges will be transformative;
- appropriate software architectures and lifecycle processes, development, testing and deployment methodologies, validation and verification processes, end usability and interface considerations, and required infrastructure and technologies;
- the required organizational, personnel and management structures and operational processes;
- the requirements and necessary mechanisms for human resource development, including integration of education and training, mentoring of students, postdoctoral fellows as well as software professionals, and proactively addressing diversity and broadening participation;
- potential approaches for long-term sustainability of the software infrastructure as well as the software; and
- potential risks including risks associated with establishment and execution, necessary infrastructure and associated technologies, community engagement, and long-term sustainability.

The strategic plan resulting from the conceptualization phase is expected to serve as the conceptual design upon which a subsequent S2I2 Implementation proposal could be based.

(b) S2I2 Implementation Awards: The S2I2 Implementation Awards will be made to implement community strategic plans, such as those outlined in conceptualization phase described above. It is expected that proposals for Implementation Awards will be considered in response to specific areas that are explicitly identified by NSF. The size of these awards as well as the structure of the institute will be based on the targeted community and its needs. Awards are expected to be cooperative agreements between NSF and the awardee(s), and funds will be released annually subject to agreed-to milestones, and based on approval by NSF and the availability of funds. New S2I2 awards will be funded for 5 years and will consist of the following two phases:

S2I2 Design Phase: The goal of the S2I2 design phase is to support required institute design and ramp-up activities and to demonstrate readiness for the execution phase. This phase is expected to last up to 2 years. The S2I2 design phase will focus on concrete design and implementation activities necessary for the execution of the institute, and will result in a Project Execution Plan that provides the following: a detailed breakdown of the products and services that will be provided by the institute; the policies and mechanisms for community software integration as well as its integration with concomitant cyberinfrastructure ecosystems; software architecture and development methodologies and lifecycle processes; staffing and organizational structure; metrics, governance structures and advisory and oversight mechanisms; schedule for implementation with milestones; detailed budget requirements and basis for cost estimates; and a summary of the major risks and mitigation and contingency plans. The Project Execution Plan will be reviewed to assess readiness of the project to move to the execution phase.

S2I2 Execution Phase: In the S2I2 execution phase, the institute is expected to be completely staffed and operational, and fulfilling the proposed mission. 18 Months prior to the end of the award, the institute will be evaluated by an external committee based on the goals of the SI ^{2} programs as well as specific metrics outlined in the proposal. Depending on the outcome of the review NSF may choose to implement a phase-down plan for the remaining duration of the award. Successful institutes will continue to receive the planned support through the remainder of the grant period.

Industry and International Participation in SI ^{2}: NSF encourages participation by industry and international collaborators in all classes of SI ^{2} awards where it clearly strengthens the proposed activity (e.g., involvement of specific and unique expertise or resources or addressing sustainability).

- International participants are encouraged to seek support from their funding organizations. NSF funds may not be used to support the expenses of international researchers at their home institution. However, NSF funds may be used for travel expenses for US scientists and students in exchange integral to the project, or for international collaborators to participate in activities in the US. For those who plan to submit a proposal with international counterparts, please consult NSF Policies and Practices for International Engagements.
- The SI^2 program recognizes that software is a fundamental infrastructure that cross-cuts academic, government, civic, and commercial organizations. The program encourages proposals to explore novel partnerships beyond academe wherever beneficial and permissible within the guidelines of the NSF GPG.

III. AWARD INFORMATION

Estimated program budget, size and number of awards is subject to the availability of funds. Pending availability of funds, up to $2,500,000 will be available for proposals submitted in response to this solicitation. The typical size of a S2I2 Conceptualization award is expected to be $500,000 for 1 year.

IV. ELIGIBILITY INFORMATION

Organization Limit:

Proposals may only be submitted by the following:

- Universities and Colleges - Universities and two- and four-year colleges (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Such organizations also are referred to as academic institutions.
- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.

PI Limit:

None Specified

Limit on Number of Proposals per Organization:

None Specified

Limit on Number of Proposals per PI:

None Specified

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Full Proposal Preparation Instructions: Proposers may opt to submit proposals in response to this Program Solicitation via Grants.gov or via the NSF FastLane system.

- Full proposals submitted via FastLane: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the NSF Grant Proposal Guide (GPG). The complete text of the GPG is available electronically on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg. Paper copies of the GPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov. Proposers are reminded to identify this program solicitation number in the program solicitation block on the NSF Cover Sheet For Proposal to the National Science Foundation. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.

- Full proposals submitted via Grants.gov: Proposals submitted in response to this program solicitation via Grants.gov should be prepared and submitted in accordance with the NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov. The complete text of the NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at: (http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide). To obtain copies of the Application Guide and Application Forms Package, click on the Apply tab on the Grants.gov site, then click on the Apply Step 1: Download a Grant Application Package and Application Instructions link and enter the funding opportunity number, (the program solicitation number without the NSF prefix) and press the Download Package button. Paper copies of the Grants.gov Application Guide also may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov.

In determining which method to utilize in the electronic preparation and submission of the proposal, please note the following:

Collaborative Proposals. All collaborative proposals submitted as separate submissions from multiple organizations must be submitted via the NSF FastLane system. Chapter II, Section D.4 of the Grant Proposal Guide provides additional information on collaborative proposals.

Cover Sheet: Provide a short informative title for the proposed S2I2 project. The system allows one PI and at most four Co-PIs to be designated for each proposal. If your project involves international partners, check the international activities box and list the countries involved. If needed, additional lead personnel should be designated as non co-PI, Senior Personnel on the Budget form.

Project Summary (1-page limit):

The Project Summary consists of an overview, a statement on the intellectual merit of the proposed activity, and a statement on the broader impacts of the proposed activity.

The overview includes a description of the S2I2 project (including its transformative research and education goals, the innovative software infrastructure being proposed, and the community (communities) that will be impacted) that would result if the proposal were funded and a statement of objectives and methods to be employed. The statement on intellectual merit should describe the potential of the proposed activity to advance knowledge. The statement on broader impacts should describe the potential of the proposed activity to benefit society and contribute to the achievement of specific, desired societal outcomes. The Project Summary should be written in the third person, informative to other persons working in the same or related fields, and, insofar as possible, understandable to a scientifically or technically literate lay reader. It should not be an abstract of the proposal.

Proposals that do not contain the Project Summary, including an overview and separate statements on intellectual merit and broader impacts will not be accepted by FastLane or will be returned without review. Additional instructions for preparation of the Project Summary are available in FastLane.

Project Description

S2I2 Conceptualization Proposals (15-page limit):

The Project Description should provide a clear statement of the work to be undertaken and must include: objectives for the period of the proposed work and expected significance; relation to longer-term goals of the PI's project; and relation to the present state of knowledge in the field, to work in progress by the PI under other support and to work in progress elsewhere.

The Project Description should outline the general plan of work, including the broad design of activities to be undertaken, and, where appropriate, provide a clear description of experimental methods and procedures. Proposers should address what they want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits could accrue if the project is successful. The project activities may be based on previously established and/or innovative methods and approaches, but in either case must be well justified. These issues apply to both the technical aspects of the proposal and the way in which the project may make broader contributions.

The Project Description must contain, as a separate section within the narrative, a discussion of the broader impacts of the proposed activities. Broader impacts may be accomplished through the research itself, through the activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to the project. NSF values the advancement of scientific knowledge and activities that contribute to the achievement of societally relevant outcomes. Such outcomes include, but are not limited to: full participation of women, persons with disabilities, and underrepresented minorities in science, technology, engineering, and mathematics (STEM); improved STEM education and educator development at any level; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a diverse, globally competitive STEM workforce; increased partnerships between academia, industry, and others; improved national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education.

For S2I2 Proposals, the Project Description should clearly describe:

- The rationale for the envisioned institute, it mission and goals, and it responsiveness to community needs and to programmatic areas of interest to the SI ^{2} program and associated DCLs.
- The scientific communities and software elements/frameworks targeted, and the specific software sustainability challenges that will be addressed.
- Approaches for reaching out to the relevant communities and engaging them in the conceptual design process.
- The anticipated impact to the scientific communities in terms of research, innovation and productivity.
- The overarching approach as well as specific steps that will be taken towards the conceptual design of the envisioned institute.
- A steering committee composed of leading members of the targeted community that could assume key roles in the leadership and/or management of the envisioned institute. A brief biography of the members of the steering committee and their role in the conceptualization process should be included.

The proposal should also clearly outline what qualifies the PIs to lead the conceptualization effort for the envisioned institute.

Required Documents

In addition to *Data Management Plan* and the *Postdoctoral Research Mentoring Plan (* if required), the following items are the only items permitted as supplementary documentation, single copy documents, or appendices. Unless otherwise instructed, documentation should be saved and uploaded as a single Portable Document Format (PDF) file.

Project Personnel (a text-searchable PDF document uploaded as a Single Copy Document). List all Senior Personnel in the project. For each person, provide the last name, first name, and institution/organization. In the main body of the proposal, a corresponding biographical sketch should be provided for all individuals included on this list, as instructed in Section II.C.2.f of the Grant Proposal Guide.

List of Personnel, Collaborators and Affiliates (electronic document, proposers must send the following document immediately after submission of the proposal)

On receipt of the proposal number after submission, send an e-mail to si2@nsf.gov. The subject heading of the e-mail should note the proposal number and the lead institution. Attach a file in CSV "flat text" format (e.g., by saving an Excel spreadsheet as a CSV file), which lists the full names and institutional affiliations of all people having potential conflicts of interest (COI) with any PIs, Co-PIs, and other senior personnel (SP). Potential conflicts of interest, as specified in the NSF's Grant Proposal Guide, include co-authors/editors and collaborators (within the past 48 months), all graduate advisors and advisees, and any other individuals or institutions with which the investigator has financial ties. The columns of the spreadsheet should be "proposal number", "PI/SP Last Name", "PI/SP First Name", "PI/SP Institution", "COI Last Name", "COI First Name", "COI Institution". This list will be used by NSF to check for conflicts of interest in assembling the review community. The filename should be the proposal number (which begins with "13"; not the temporary proposal number used during proposal preparation) followed by the three characters "coi" (for example, for a proposal number 1323456, this file name will be 1323456coi.csv). The 7-digit proposal number beginning with "13" should appear in every row of the file. Each project participant should be listed (repeatedly) in all rows that name his/her conflicted individuals.

NOTE: Full proposals that fail to provide the above listed documents with proper information and according to the required format will be returned without review.

Letters of Commitment (Optional): Include only official letters of commitment with specific commitments of resources from participating institutions or organizations anticipated to receive subawards, or from organizations that will provide resources for the project. Scan your signed letters and upload them into the Supplementary Documents section of Fastlane or Grants.gov, but do not send originals. Do not submit letters of support, which do not provide specific commitments of resources. For example, letters of endorsement and letters of a laudatory nature for the proposed project are not acceptable.

No other items or appendices are to be included. ***Full proposals containing items other than those required above or by the Grant Proposal Guide (GPG) will not be reviewed.***

B. Budgetary Information

Cost Sharing: Inclusion of voluntary committed cost sharing is prohibited

Budget Preparation Instructions:

All awardees are expected to participate in an annual SI ^{2} PI meeting with travel costs supported by the award. These travel costs should be included in the FastLane budget.

C. Due Dates

- **Full Proposal Deadline(s)** (due by 5 p.m. proposer's local time):

  February 04, 2013

D. FastLane / Grants.gov Requirements

- **For Proposals Submitted Via FastLane:**

  Detailed technical instructions regarding the technical aspects of preparation and submission via FastLane are available at: https://www.fastlane.nsf.gov/a1/newstan.htm. For FastLane user support, call the FastLane Help Desk at 1-800-673-6188 or e-mail fastlane@nsf.gov. The FastLane Help Desk answers general technical questions related to the use of the FastLane system. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this funding opportunity.

  Submission of Electronically Signed Cover Sheets. The Authorized Organizational Representative (AOR) must electronically sign the proposal Cover Sheet to submit the required proposal certifications (see Chapter II, Section C of the Grant Proposal Guide for a listing of the certifications). The AOR must provide the required electronic certifications within five working days following the electronic submission of the proposal. Further instructions regarding this process are available on the FastLane Website at: https://www.fastlane.nsf.gov/fastlane.jsp.

- **For Proposals Submitted Via Grants.gov:**

  Before using Grants.gov for the first time, each organization must register to create an institutional profile. Once registered, the applicant's organization can then apply for any federal grant on the Grants.gov website. Comprehensive information about using Grants.gov is available on the Grants.gov Applicant Resources webpage: http://www07.grants.gov/applicants/app_help_reso.jsp. In addition, the NSF Grants.gov Application Guide provides additional technical guidance regarding preparation of proposals via Grants.gov. For Grants.gov user support, contact the Grants.gov Contact Center at 1-800-518-4726 or by email: support@grants.gov. The Grants.gov Contact Center answers general technical questions related to the use of Grants.gov. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

  Submitting the Proposal: Once all documents have been completed, the Authorized Organizational Representative (AOR) must submit the application to Grants.gov and verify the desired funding opportunity and agency to which the application is submitted. The AOR must then sign and submit the application to Grants.gov. The completed application will be transferred to the NSF FastLane system for further processing.

VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

Proposals received by NSF are assigned to the appropriate NSF program for acknowledgement and, if they meet NSF requirements, for review. All proposals are carefully reviewed by a scientist, engineer, or educator serving as an NSF Program Officer, and usually by three to ten other persons outside NSF either as *ad hoc* reviewers, panelists, or both, who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with oversight of the review process. Proposers are invited to suggest names of persons they believe are especially well qualified to review the proposal and/or persons they would prefer not review the proposal. These suggestions may serve as one source in the reviewer selection process at the Program Officer's discretion. Submission of such names, however, is optional. Care is taken to ensure that reviewers have no conflicts of interest with the proposal. In addition, Program Officers may obtain comments from site visits before recommending final action on proposals. Senior NSF staff further review recommendations for awards. A flowchart that depicts the entire NSF proposal and award process (and associated timeline) is included in the GPG as Exhibit III-1 .

A comprehensive description of the Foundation's merit review process is available on the NSF website at: http://www.nsf.gov/bfa/dias/policy/meritreview/.

Proposers should also be aware of core strategies that are essential to the fulfillment of NSF's mission, as articulated in *Empowering the Nation Through Discovery and Innovation: NSF Strategic Plan for Fiscal Years (FY) 2011-2016* . These strategies are integrated in the program planning and implementation process, of which proposal review is one part. NSF's mission is particularly well-implemented through the integration of research and education and broadening participation in NSF programs, projects, and activities.

One of the core strategies in support of NSF's mission is to foster integration of research and education through the programs, projects and activities it supports at academic and research institutions. These institutions provide abundant opportunities where individuals may concurrently assume responsibilities as researchers, educators, and students, and where all can engage in joint efforts that infuse education with the excitement of discovery and enrich research through the variety of learning perspectives.

Another core strategy in support of NSF's mission is broadening opportunities and expanding participation of groups, institutions, and geographic regions that are underrepresented in STEM disciplines, which is essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.

A. Merit Review Principles and Criteria

The National Science Foundation strives to invest in a robust and diverse portfolio of projects that creates new knowledge and enables breakthroughs in understanding across all areas of science and engineering research and education. To identify which projects to support, NSF relies on a merit review process that incorporates consideration of both the technical aspects of a proposed project and its potential to contribute more broadly to advancing NSF's mission "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes." NSF makes every effort to conduct a fair, competitive, transparent merit review process for the selection of projects.

1. Merit Review Principles

These principles are to be given due diligence by PIs and organizations when preparing proposals and managing projects, by reviewers when reading and evaluating proposals, and by NSF program staff when determining whether or not to recommend proposals for funding and while overseeing awards. Given that NSF is the primary federal agency charged with nurturing and supporting excellence in basic research and education, the following three principles apply:

- All NSF projects should be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge.
- NSF projects, in the aggregate, should contribute more broadly to achieving societal goals. These "Broader Impacts" may be accomplished through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. The project activities may be based on previously established and/or innovative methods and approaches, but in either case must be well justified.
- Meaningful assessment and evaluation of NSF funded projects should be based on appropriate metrics, keeping in mind the likely correlation between the effect of broader impacts and the resources provided to implement projects. If the size of the activity is limited, evaluation of that activity in isolation is not likely to be meaningful. Thus, assessing the effectiveness of these activities may best be done at a higher, more aggregated, level than the individual project.

With respect to the third principle, even if assessment of Broader Impacts outcomes for particular projects is done at an aggregated level, PIs are expected to be accountable for carrying out the activities described in the funded project. Thus, individual projects should include clearly stated goals, specific descriptions of the activities that the PI intends to do, and a plan in place to document the outputs of those activities.

These three merit review principles provide the basis for the merit review criteria, as well as a context within which the users of the criteria can better understand their intent.

2. Merit Review Criteria

All NSF proposals are evaluated through use of the two National Science Board approved merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two merit review criteria are listed below. **Both** criteria are to be given **full consideration** during the review and decision-making processes; each criterion is necessary but neither, by itself, is sufficient. Therefore, proposers must fully address both criteria. (GPG Chapter II.C.2.d.i. contains additional information for use by proposers in development of the Project Description section of the proposal.) Reviewers are strongly encouraged to review the criteria, including GPG Chapter II.C.2.d.i. , prior to the review of a proposal.

When evaluating NSF proposals, reviewers will be asked to consider what the proposers want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits could accrue if the project is successful. These issues apply both to the technical aspects of the proposal and the way in which the project may make broader contributions. To that end, reviewers will be asked to evaluate all proposals against two criteria:

- **Intellectual Merit:** The Intellectual Merit criterion encompasses the potential to advance knowledge; and
- **Broader Impacts:** The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The following elements should be considered in the review for both criteria:

1. What is the potential for the proposed activity to
    a. Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and
    b. Benefit society or advance desired societal outcomes (Broader Impacts)?
2. To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?
3. Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?
4. How well qualified is the individual, team, or organization to conduct the proposed activities?
5. Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?

Broader impacts may be accomplished through the research itself, through the activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. NSF values the advancement of scientific

knowledge and activities that contribute to achievement of societally relevant outcomes. Such outcomes include, but are not limited to: full participation of women, persons with disabilities, and underrepresented minorities in science, technology, engineering, and mathematics (STEM); improved STEM education and educator development at any level; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a diverse, globally competitive STEM workforce; increased partnerships between academia, industry, and others; improved national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education.

Proposers are reminded that reviewers will also be asked to review the Data Management Plan and the Postdoctoral Researcher Mentoring Plan, as appropriate.

Additional Solicitation Specific Review Criteria

S2I2 Conceptualization Awards

- The rationale for the envisioned institute, its mission and goals, and its responsiveness to community needs.
- The appropriateness and readiness of the scientific communities and software elements/frameworks targeted and the specific software sustainability challenges that will be addressed.
- The effectiveness of the approaches for reaching out to the relevant communities and engaging them in the conceptual design process.
- The anticipated impact to the scientific communities in terms of research, innovation, education and productivity.
- The appropriateness of the overarching approach as well as specific steps that will be taken to towards the conceptual design of the envisioned institute.
- The qualifications and experience of the PIs.

B. Review and Selection Process

Proposals submitted in response to this program solicitation will be reviewed by Ad hoc Review and/or Panel Review.

Reviewers will be asked to formulate a recommendation to either support or decline each proposal. The Program Officer assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation.

After scientific, technical and programmatic review and consideration of appropriate factors, the NSF Program Officer recommends to the cognizant Division Director whether the proposal should be declined or recommended for award. NSF is striving to be able to tell applicants whether their proposals have been declined or recommended for funding within six months. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director accepts the Program Officer's recommendation.

A summary rating and accompanying narrative will be completed and submitted by each reviewer. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers, are sent to the Principal Investigator/Project Director by the Program Officer. In addition, the proposer will receive an explanation of the decision to award or decline funding.

In all cases, after programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements for review of business, financial, and policy implications and the processing and issuance of a grant or other agreement. Proposers are cautioned that only a Grants and Agreements Officer may make commitments, obligations or awards on behalf of NSF or authorize the expenditure of funds. No commitment on the part of NSF should be inferred from technical or budgetary discussions with a NSF Program Officer. A Principal Investigator or organization that makes financial or personnel commitments in the absence of a grant or cooperative agreement signed by the NSF Grants and Agreements Officer does so at their own risk.

VII. AWARD ADMINISTRATION INFORMATION

A. Notification of the Award

Notification of the award is made to *the submitting organization* by a Grants Officer in the Division of Grants and Agreements. Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided automatically to the Principal Investigator. (See Section VI.B. for additional information on the review process.)

B. Award Conditions

An NSF award consists of: (1) the award letter, which includes any special provisions applicable to the award and any numbered amendments thereto; (2) the budget, which indicates the amounts, by categories of expense, on which NSF has based its support (or otherwise communicates any specific approvals or disapprovals of proposed expenditures); (3) the proposal referenced in the award letter; (4) the applicable award conditions, such as Grant General Conditions (GC-1); * or Research Terms and Conditions * and (5) any announcement or other NSF issuance that may be incorporated by reference in the award letter. Cooperative agreements also are administered in accordance with NSF Cooperative Agreement Financial and Administrative Terms and Conditions (CA-FATC) and the applicable Programmatic Terms and Conditions. NSF awards are electronically signed by an NSF Grants and Agreements Officer and transmitted electronically to the organization via e-mail.

*These documents may be accessed electronically on NSF's Website at http://www.nsf.gov/awards/managing/award_conditions.jsp?org=NSF. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from nsfpubs@nsf.gov.

More comprehensive information on NSF Award Conditions and other important information on the administration of NSF awards is contained in the NSF *Award & Administration Guide* (AAG) Chapter II, available electronically on the NSF Website at

http://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag.

Special Award Conditions:

All awardees are expected to participate in an annual SI ^{2} PI meeting with travel costs supported by the award.

C. Reporting Requirements

For all multi-year grants (including both standard and continuing grants), the Principal Investigator must submit an annual project report to the cognizant Program Officer at least 90 days prior to the end of the current budget period. (Some programs or awards require submission of more frequent project reports). Within 90 days following expiration of a grant, the PI also is required to submit a final project report, and a project outcomes report for the general public.

Failure to provide the required annual or final project reports, or the project outcomes report, will delay NSF review and processing of any future funding increments as well as any pending proposals for all identified PIs and co-PIs on a given award. PIs should examine the formats of the required reports in advance to assure availability of required data.

PIs are required to use NSF's electronic project-reporting system, available through Research.gov, for preparation and submission of annual and final project reports. Such reports provide information on accomplishments, project participants (individual and organizational), publications, and other specific products and impacts of the project. Submission of the report via Research.gov constitutes certification by the PI that the contents of the report are accurate and complete. The project outcomes report also must be prepared and submitted using Research.gov. This report serves as a brief summary, prepared specifically for the public, of the nature and outcomes of the project. This report will be posted on the NSF website exactly as it is submitted by the PI.

More comprehensive information on NSF Reporting Requirements and other important information on the administration of NSF awards is contained in the NSF *Award & Administration Guide* (AAG) Chapter II, available electronically on the NSF Website at http://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag.

VIII. AGENCY CONTACTS

Please note that the program contact information is current at the time of publishing. See program website for any updates to the points of contact.

General inquiries regarding this program should be made to:

- Daniel S. Katz, Program Director, OD/OCI, telephone: (703) 292-2254, email: SI2queries@nsf.gov
- Peter H. McCartney, Program Director, BIO/DBI, telephone: (703) 292-8470, email: SI2Queries@nsf.gov
- Sumanta Acharya, Program Director, ENG/CBET, telephone: (703) 292-7494, email: SI2queries@nsf.gov
- Clark Cooper, Program Director, ENG/CMMI, telephone: (703) 292-7899, email: SI2Queries@nsf.gov
- Eduardo A. Misawa, Program Director, ENG/EEC, telephone: (703) 292-5353, email: SI2Queries@nsf.gov
- Jean Cottam Allen, Program Director, MPS/PHY, telephone: (703) 292-8783, email: SI2queries@nsf.gov
- Daryl W. Hess, Program Director, MPS/DMR, telephone: (703) 292-4942, email: SI2Queries@nsf.gov
- Andrew D. Pollington, Program Director, MPS/DMS, telephone: (703) 292-4878, email: SI2Queries@nsf.gov
- Thomas Statler, Program Officer, MPS/AST, telephone: (703) 292-4910, email: SI2queries@nsf.gov

For questions related to the use of FastLane, contact:

- FastLane Help Desk, telephone: 1-800-673-6188; e-mail: fastlane@nsf.gov.

For questions relating to Grants.gov contact:

- Grants.gov Contact Center: If the Authorized Organizational Representatives (AOR) has not received a confirmation message from Grants.gov within 48 hours of submission of application, please contact via telephone: 1-800-518-4726; e-mail: support@grants.gov.

IX. OTHER INFORMATION

The NSF Website provides the most comprehensive source of information on NSF Directorates (including contact information), programs and funding opportunities. Use of this Website by potential proposers is strongly encouraged. In addition, National Science Foundation Update is a free e-mail subscription service designed to keep potential proposers and other interested parties apprised of new NSF funding opportunities and publications, important changes in proposal and award policies and procedures, and upcoming NSF Regional Grants Conferences. Subscribers are informed through e-mail when new publications are issued that match their identified interests. Users can subscribe to this service by clicking the "Get NSF Updates by Email" link on the NSF web site.

Grants.gov provides an additional electronic capability to search for Federal government-wide grant opportunities. NSF funding opportunities may be accessed via this new mechanism. Further information on Grants.gov may be obtained at http://www.grants.gov.

Related Programs:

See also:

- A Vision and Strategy for Software for Science, Engineering, and Education -- http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf12113
- Implementation of NSF Software Vision -- http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504817

ABOUT THE NATIONAL SCIENCE FOUNDATION

The National Science Foundation (NSF) is an independent Federal agency created by the National Science Foundation Act of 1950, as amended (42 USC 1861-75). The Act states the purpose of the NSF is "to promote the progress of science; [and] to advance the national health, prosperity, and welfare by supporting research and education in all fields of science and engineering."

NSF funds research and education in most fields of science and engineering. It does this through grants and cooperative agreements to more than 2,000 colleges, universities, K-12 school systems, businesses, informal science organizations and other research organizations throughout the US. The Foundation accounts for about one-fourth of Federal support to academic institutions for basic research.

NSF receives approximately 55,000 proposals each year for research, education and training projects, of which approximately 11,000 are funded. In addition, the Foundation receives several thousand applications for graduate and postdoctoral fellowships. The agency operates no laboratories itself but does support National Research Centers, user facilities, certain oceanographic vessels and Arctic and Antarctic research stations. The Foundation also supports cooperative research between universities and industry, US participation in international scientific and engineering efforts, and educational activities at every academic level.

Facilitation Awards for Scientists and Engineers with Disabilities provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See Grant Proposal Guide Chapter II, Section D.2 for instructions regarding preparation of these types of proposals.

The National Science Foundation has Telephonic Device for the Deaf (TDD) and Federal Information Relay Service (FIRS) capabilities that enable individuals with hearing impairments to communicate with the Foundation about NSF programs, employment or general information. TDD may be accessed at (703) 292-5090 and (800) 281-8749, FIRS at (800) 877-8339.

The National Science Foundation Information Center may be reached at (703) 292-5111.

The National Science Foundation promotes and advances scientific progress in the United States by competitively awarding grants and cooperative agreements for research and education in the sciences, mathematics, and engineering.

To get the latest information about program deadlines, to download copies of NSF publications, and to access abstracts of awards, visit the NSF Website at http://www.nsf.gov

- **Location:** 4201 Wilson Blvd. Arlington, VA 22230
- **For General Information** (NSF Information Center) **:** (703) 292-5111
- **TDD (for the hearing-impaired):** (703) 292-5090
- **To Order Publications or Forms:**

  Send an e-mail to: nsfpubs@nsf.gov

  or telephone: (703) 292-7827
- **To Locate NSF Employees:** (703) 292-5111

PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; and project reports submitted by awardees will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the proposal review process; to proposer institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies or other entities needing information regarding applicants or nominees as part of a joint application review process, or in order to coordinate programs or policy; and to another Federal agency, court, or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004), and NSF-51, "Reviewer/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004). Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

An agency may not conduct or sponsor, and a person is not required to respond to, an information collection unless it displays a

valid Office of Management and Budget (OMB) control number. The OMB control number for this collection is 3145-0058. Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding the burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to:

Suzanne H. Plimpton
Reports Clearance Officer
Division of Administrative Services
National Science Foundation
Arlington, VA 22230